

Claims

- [c1] 1. An InAs/GaAs quantum dot light emitting diode which is formed by turning off an As shutter and using As background concentration for epitaxy, comprising: a Si-doped GaAs substrate, a N-type structure, an undoped quantum well, a series of quantum dot layers, spacer layers, a barrier layer and a P-type structure.
- [c2] 2. The InAs/GaAs quantum dot light emitting diode of claim 1, wherein an InAs quantum dot layer is formed by using the As background concentration for epitaxy when the As shield is turned off.
- [c3] 3. The InAs/GaAs quantum dot light emitting diode of claim 1, wherein the Si doped GaAs substrate is a $(001)\pm 1^\circ$ substrate and has dopant concentration from about 1×10^{18} to about $1\times 10^{19} \text{ cm}^{-3}$ when substrate temperature is raised to 610°C to about 650°C .
- [c4] 4. The InAs/GaAs quantum dot light emitting diode of claim 3, wherein the N-type structure comprising a GaAs buffer layer having a thickness about from 500 nm to about 2000 nm and dopant concentration from about 1×10^{18} to about $5\times 10^{18} \text{ cm}^{-3}$ formed on the substrate,

and a $\text{Al}_x\text{Ga}_{1-x}\text{As}$ cap layer having a thickness about from 200 nm to about 800 nm and dopant concentration from about 1×10^{18} to about $5 \times 10^{18} \text{ cm}^{-3}$ formed on the GaAs buffer layer, wherein x is about 0.3–0.7 when substrate temperature is raised to 610°C to about 650°C .

[c5] 5. The InAs/GaAs quantum dot light emitting diode of claim 3, wherein the undoped quantum well layer comprises two to ten multi-layer GaAs /undoped $\text{Al}_x\text{Ga}_{1-x}\text{As}$ quantum wells formed on the cap layer, wherein each quantum well has a thickness about from 3 nm to about 7 nm, and x is about 0.3–0.7 when substrate temperature is down to 580°C to about 615°C .

[c6] 6. The InAs/GaAs quantum dot light emission diode of claim 5, wherein the quantum dot layer, the spacer layer and the barrier layer comprise three to ten InAs quantum dot molecular layers formed on the quantum wells, wherein each quantum dot molecular layer has a thickness from about 2.5 molecular layer (ML) to about 4.5 ML, when substrate temperature is down to 470°C to about 520°C ; the each quantum dot layer covered with an undoped InAs spacer layer having a thickness from about 10 nm to about 40 nm; and a GaAs barrier layer having a thickness from about 10 nm to about 50 nm is formed on the last spacer layer.

[c7] 7. The InAs/GaAs quantum dot light emission diode of claim 6, wherein the P-type structure comprises a $\text{Al}_{1-x}\text{Ga}_x\text{As}$ cap layer 8 having a thickness from about 300 nm to about 700 nm formed on the GaAs barrier layer, wherein x is about 0.3–0.7 and Be concentration is from about 1×10^{18} to about $1 \times 10^{19} \text{ cm}^{-3}$; and a GaAs contact layer having a thickness from about 300 nm to about 1000 nm formed on the cap layer, which is doped with Be having concentration from about 5×10^{18} to about $5 \times 10^{19} \text{ cm}^{-3}$.